Remarks

Claims 81-90, 104, 105, 111 and 112 are pending in the Application.

Claims 81-87, 104, 105, 111 and 112 are rejected.

Claims 88-90 are objected to.

I. REJECTIONS UNDER 35 U.S.C. §§ 102 and 103

Examiner has maintained the rejection of Claims 81-87 under 35 U.S.C. § 102(a) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Ajayan et al., *Science*, ("*Ajayan*"). Office Action, at 2. Examiner has also maintained his rejection of Claims 104, 105, 111 and 112 under 35 U.S.C. § 103(a) as obvious over *Ajayan* taken with "applicant's admissions." *Id.*

During a recent discussion with Examiner, the Applicant understands Applicant's prior amendment to the claims (considered with Applicant's Request for RCE, filed January 11, 2005) did not conform to the Examiner's understanding of how the claims would be amended. Applicant intended to amend the claims in view of its interview with Examiner; to the extent that Applicant did not fully amend the claims consistent with the interview, such discrepancy was un-intentional. To further clarify the scope of the claims, Applicant has again amended the independent claims.

In the Office Action, the Examiner stated that "[t]he claims have not been narrowed to the argued feature that all the nanotubes present are aligned and have the same size." Office Action, at 2. Applicant has herewith modified independent Claims 81, 104, 111 and 112 to more affirmatively recite the following limitations for the molecular array (or, in the case of Claim 81, the macroscopic molecular array):

(1) all of the single-wall carbon nanotubes in the molecular array are in generally parallel orientation; and

(2) all of the single-wall carbon nanotubes in the molecular array have a substantially similar length, wherein the similar length is in the range of from about 5 to about 500 nanometers.

Applicant again notes that the scope of the claims is commensurate with the scope that Applicant had previously understood them to be and thus, the claims are not narrowed by these amendments to the claims. Applicant understands that Examiner indicated that such clarified claims would be in a form for allowance.

Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 81-87, 104-105, and 111-112 under 35 U.S.C. §§ 102 and 103.

II. CLAIMS OBJECTED TO

Examiner has maintained his objection to Claims 88-90. As Applicant understands that Examiner has indicated that the modified independent claims from which Claims 88-90 now depend are in form for allowance, Applicant respectfully requests that the Examiner withdraw his objection of Claims 88-90.

III. AMENDMENTS TO THE SPECIFICATION

In the Office Action, the Examiner has requested that the Applicant resubmit page 33 of the Specification. Office Action, at 2. Applicant has attached this page 33 herewith at Attachment A. As this is an identical copy of what was formerly filed with the USPTO, no new matter is added by this re-submission.

Applicant filed the present Application on December 28, 2001 as a divisional of United States Patent Application Serial No. 09/380,545, filed on September 3, 1999 ("the Parent '545 Patent Application"). The Parent '545 Patent Application issued as United States Patent No. 6,683,783 on January 27, 2004 ("the '783 Patent").

In the Preliminary Amendment Accompanying Request For Filing Divisional Application Under 37 C.F.R. §1.53(b), filed December 28, 2001), Applicant inserted a RELATED APPLICATIONS section on page one of the Specification. Applicant has amended the first

paragraph of the inserted RELATED APPLICATIONS section to reflect the issuance of the '783 Patent. No new matter is added by this amendment to the specification.

IV. AMENDMENTS TO THE DRAWINGS

On December 28, 2001 (*i.e.*, the filing date of the present Application), Applicant concurrently filed United States Patent Application Serial No. 10/033,075 ("the '075 Patent Application"), which, like the present Application, is a divisional of the Parent '545 Patent Application.

In the '075 Patent Application, Applicant was requested by the USPTO to furnish a substitute drawing for FIGS. 17A and 17B appearing on Sheet 18/21 of the Application. As Applicant surmises that a similar request may be made in the present Application, to further facilitate prosecution, Applicant has herewith submitted for substitution the same substitute Sheet 18/21 that Applicant submitted and the USPTO accepted for the '075 Patent Application. Applicant has attached this substitute Sheet 18/21 herewith at Attachment B.

No new matter is added by this amendment to the drawings.

V. HIRSCH REFERENCE

Examiner has asked that the *Hirsch* reference be submitted. Office Action, at 2. In the Application, Applicant identified a reference authored by Andreas Hirsch, namely, A. Hirsch, "The Chemistry of the Fullerenes," Thieme, 1994. Application, at 30, *ll.* 23-24. Later in the Application, and during its description of "Molecular Arrays of Single-Wall Carbon Nanotubes," (Application, at p. 35, *l.* 1 – p. 37, *l.* 27), Applicant again cited to this reference by Professor Hirsch. *See* Application, at p. 35, *l.* 8 (stating "see Hirch [*sic*, Hirsch], pp. 75-76.") Applicant believes that these are the only two references to this *Hirsch* reference recited in the Application.

Applicant understands that the *Hirsch* reference which the Examiner has asked Applicant to submit is directed to the latter of these two citations within the Application because this is cited in a discussion respecting molecular arrays, which term is found in the preamble and/or the

body of the claim for each of the pending independent claims of the present Application. Applicant has thus attached herewith at Attachment C, pages 75-76 of this *Hirsch* reference.

As the *Hirsch* reference is a book (and thus quite lengthy), and upon discussions with the Examiner, Applicant does not understand that Examiner was requesting Applicant to submit the book in its entirety. If however, Applicant has misunderstood the materials the Examiner had asked for or if the Examiner desires additional materials, Applicant respectfully asks the Examiner to further identify the materials.

VI. CONCLUSION

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully requests allowance of such Claims.

Applicant respectfully requests that the Examiner call Applicant's attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

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Attorneys for Applicant

By: _____
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The term "aromatic or non-aromatic ring" as used herein includes 5-8 membered aromatic and non-aromatic rings uninterrupted or interrupted with one or more heteroatom, for example O, S, SO, SO_2, and N, or the ring may be unsubstituted or substituted with, for example, halogen, alkyl, acyl, hydroxy, aryl, and amino, said heteroatom and substituent may also be substituted with, for example, alkyl, acyl, aryl, or aralkyl.

The term "linear or cyclic" when used herein includes, for example, a linear chain which may optionally be interrupted by an aromatic or non-aromatic ring. Cyclic chain includes, for example, an aromatic or non-aromatic ring which may be connected to, for example, a carbon chain which either precedes or follows the ring.

The term "substituted amino" as used herein refers to an amino which may be substituted with one or more substituent, for example, alkyl, acyl, aryl, aralkyl, hydroxy, and hydrogen.

The term "substituted thiol" as used herein refers to a thiol which may be substituted with one or more substituent, for example, alkyl, acyl, aryl, aralkyl, hydroxy, and hydrogen.

Typically, open ends may contain up to about 20 substituents and closed ends may contain up to about 30 substituents. It is preferred, due to stearic hindrance, to employ up to about 12 substituents per end.

In addition to the above described external derivatization, the SWNT molecules of the present invention can be modified endohedrally, i.e., by including one or more metal atoms inside the structure, as is known in the endohedral fullerene art. It is also possible to "load" the SWNT molecule with one or more smaller molecules that do not bond to the structures, e.g., C_{60}, to permit molecular switching as the C_{60} bucky ball shuttles back and forth inside the SWNT molecule under the influence of external fields or forces.

To produce endohedral tubular carbon molecules, the internal species (e.g., metal atom, bucky ball molecules) can either be introduced during the SWNT formation process or added after preparation of the tubular molecules.

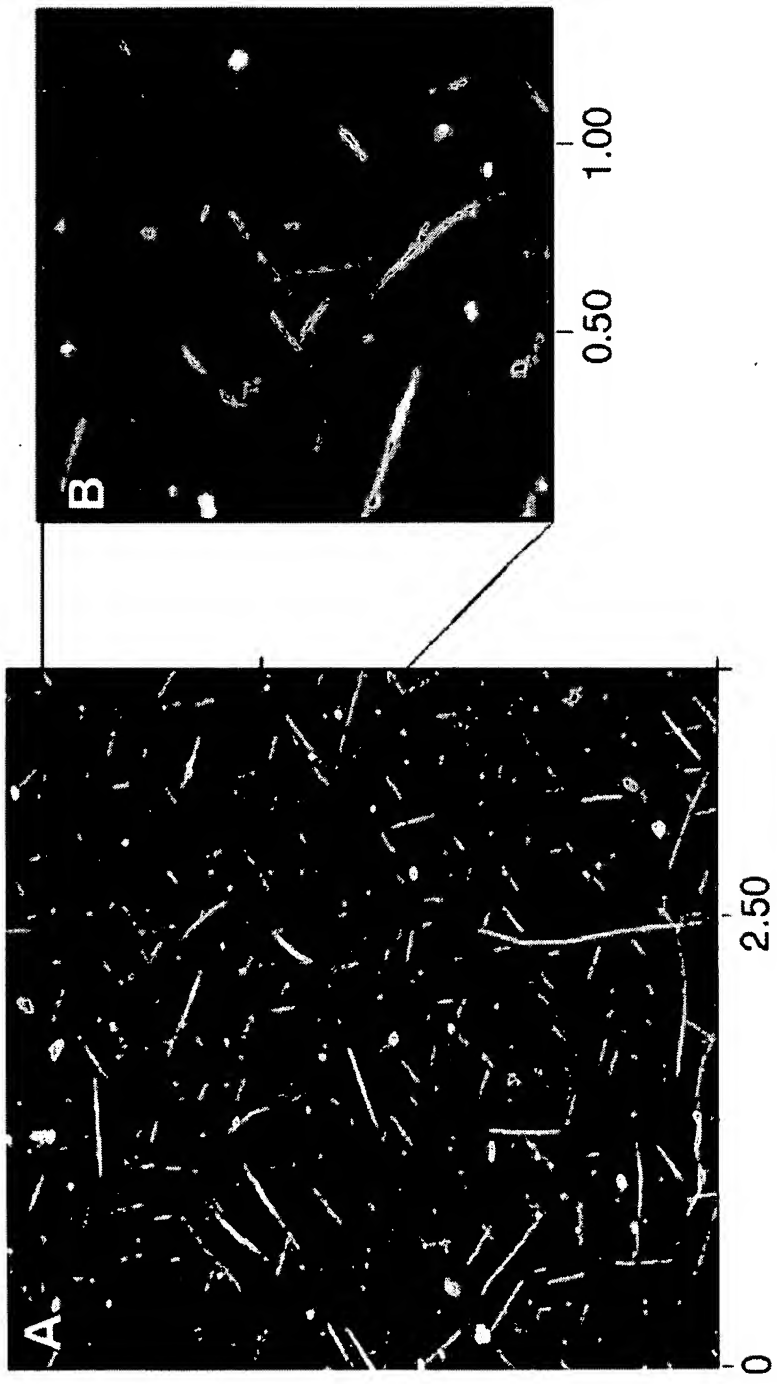


FIG. 17B

FIG. 17A

The Chemistry of the Fullerenes

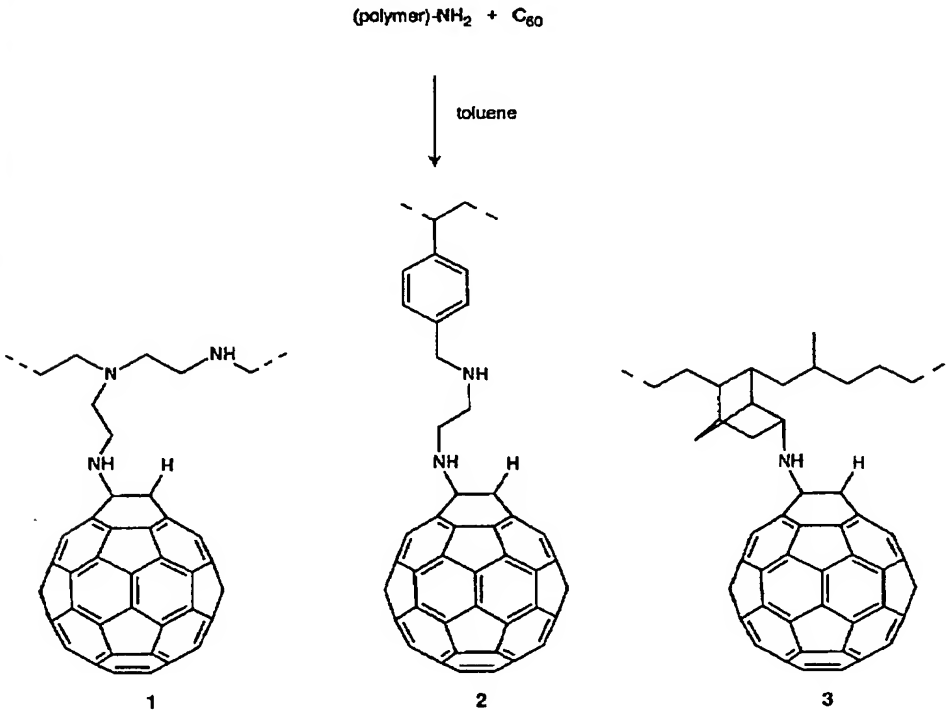
Andreas Hirsch

University of Tübingen

Georg Thieme Verlag Stuttgart • New York 1994

As shown by mass spectrometry and NMR spectroscopy, these amine derivatives of C_{60}, after work-up, are dehydrogenated adducts[29]. After nucleophilic addition, the hydrogens which are brought in by the diamines were oxidatively eliminated. The final adduct formation of the secondary diamines proceeds exclusively at 6-6 bonds. Besides the monoadduct, 6 regioisomeric bisadducts of piperazine and C_{60} were separated by column chromatography.

The facile addition of primary and secondary amines to C_{60} has been used to synthesize polymer bound C_{60} [Scheme 3.15][30,31]. Toluene solutions of precursor polymers containing primary amino groups in the side chain were allowed to react with C_{60} in a "buckyball" fishing process.

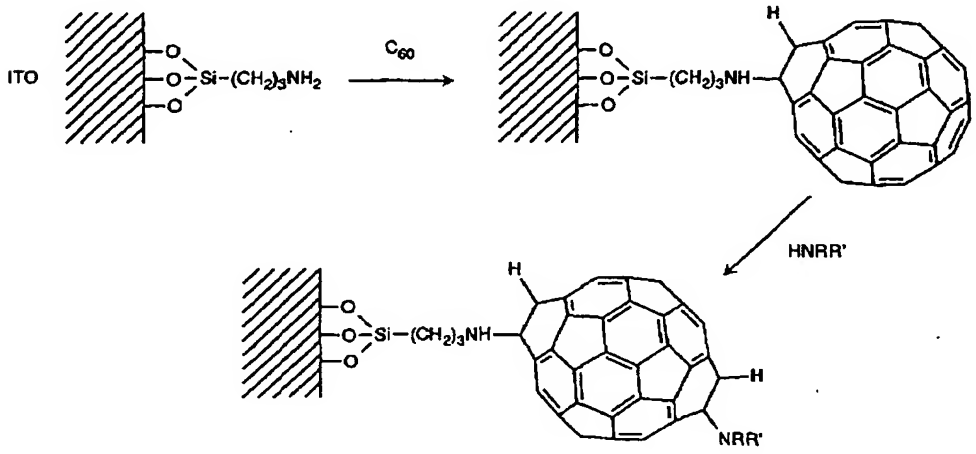


Scheme 3.15

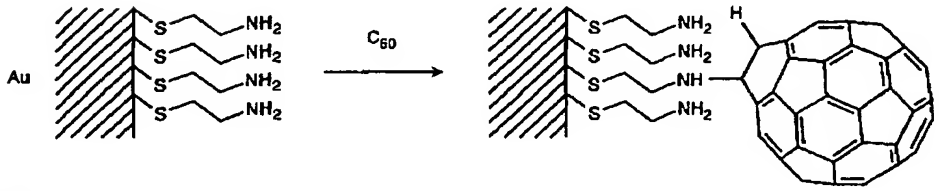
In the polymers **1** and **2** (pendant on-chain, **Ia**, Fig. 3.8) about every twentieth monomer unit of the polymer carries a buckyball as determined by quantitative titration experiments and by thermogravimetric analysis[31]. The formation of **1** proceeds in a fast process via green intermediates upon the precipitation of a light brown gel. The precursor polymer of **3**, the amine functionalized ethylene-propylene terpolymer (EPDM-amine), contains only one amine per polymer chain. Therefore, polymer **3** itself is very soluble in common organic solvents. Viscometric studies on **3** imply that more than one amino group react with the same fullerene molecule, making it a dendritic system **II**[30] [Fig. 3.8].

Self-assembled monolayers (SAMs) of covalently bound C_{60} have been synthesized by the treatment of C_{60} with $(MeO)_3Si(CH_2)_3$ modified indium-tin-oxide (ITO) surfaces [Scheme 3.16][32] as well as cysteamine modified gold surfaces [Scheme 3.17][33]. These cases also take advantage of the

fact that primary amino groups easily add to the fullerene double bonds. The use of ITO treated with $(MeO)_3Si(CH_2)_3NH_2$ and the modified gold substrates allow the electrochemical characterization of the SAMs of C_{60} with cyclic voltammetry as well as quartz crystal microbalance (QCM) measurements. With these investigations it could be shown that monolayers of C_{60} indeed are bound to the surface. The C_{60} surface coverage was determined to be 2.0×10^{-10} mol/cm^2. Although the C_{60} SAMs are stable under ambient conditions, the fullerenes may be desorbed from the surface through electrochemical reduction of the films for extended periods of time (>10 min). The monolayer can be further modified with monomeric amine reagents, which demonstrates the potential of the self-assembly process for growing three-dimensional fullerene structures [Scheme 3.16].



Scheme 3.16



Scheme 3.17

3.4 Addition of Hydroxide

Heating of C_{60}/C_{70} mixtures in toluene in the presence of excess KOH leads to the formation of a precipitate of hydroxylated fullerenes (fullerols), which are soluble in THF but decompose due to the presence of air[34]. The addition of hydroxide to C_{70} proceeds significantly faster than to C_{60}. This was

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16 D. E.
17 A. Hir
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20 I. Lan
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